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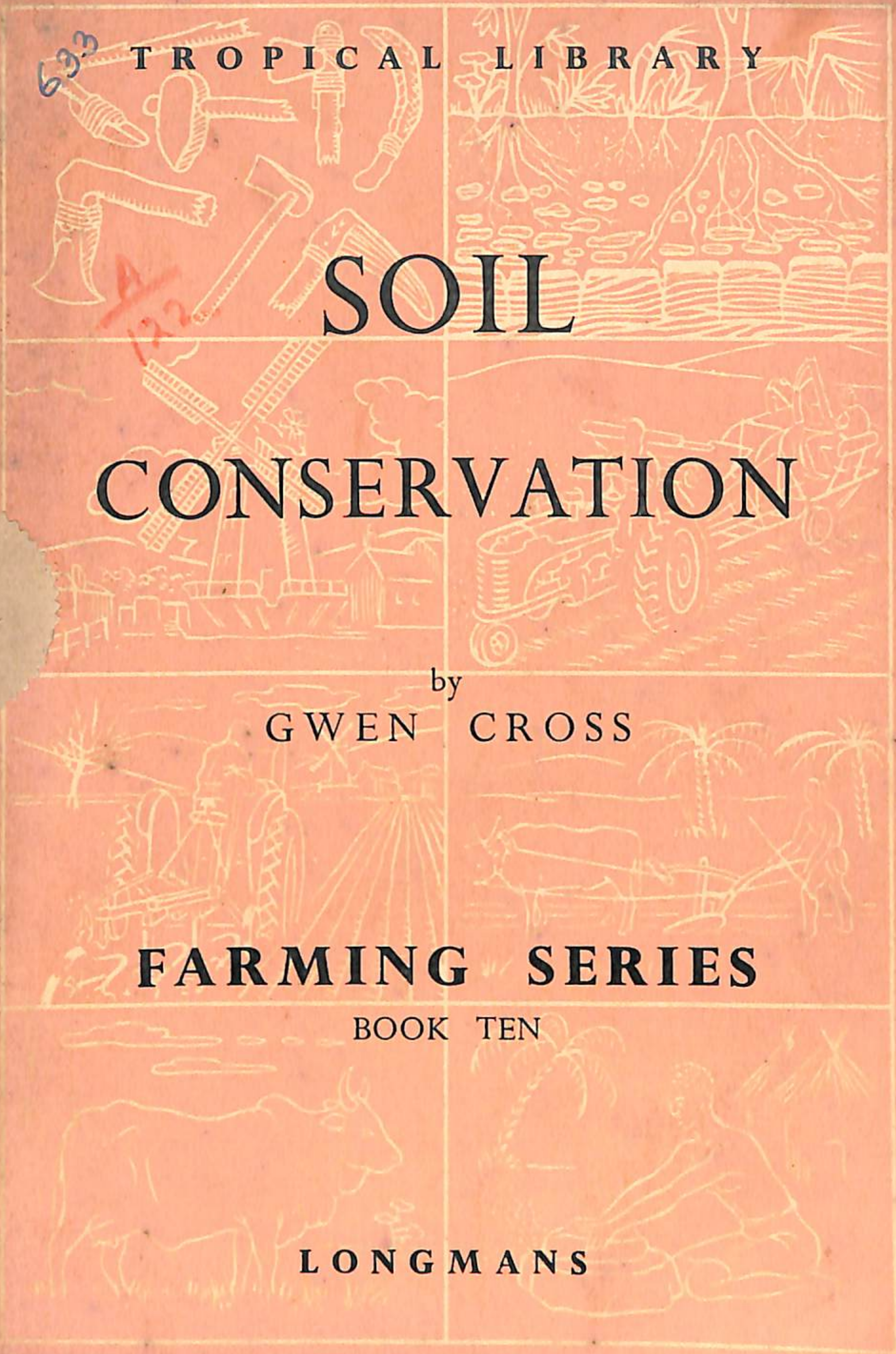

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CHAPTER 1

CHOOSING LAND FOR A GARDEN

WHEN we want to make a garden and raise crops, we must choose the best land we can find. The better we choose the easier will be the work of cultivating it, and the fewer the difficulties we shall meet. Not only do we want good soil to begin with, but we want to be able to keep it good, or even to make it better, without too much difficulty. There are many things to think about when we are trying to find land on which we can both get big harvests and conserve the soil. Here is a list of questions which we should ask ourselves:

1. Is the soil good? Is there plenty of humus in it?

2. Is the soil porous or impervious? Is it light or heavy? If we make ditches in it for drainage or for irrigation, will they be easily kept in repair?

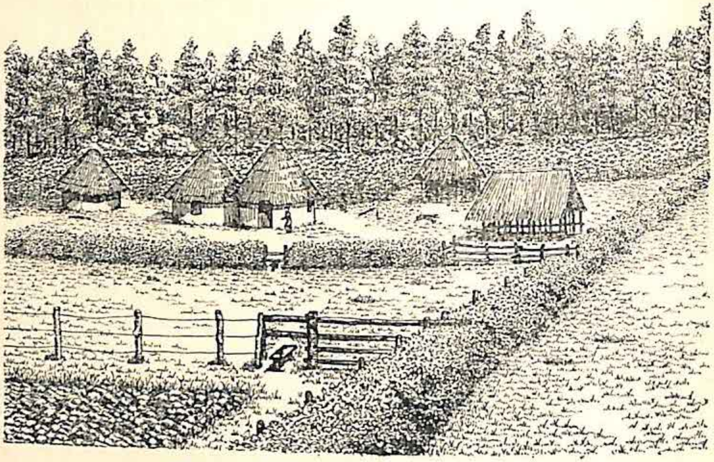
3. Does the land slope steeply or gently?

4. Is the land near the top or the bottom of a slope? Can water flow from higher land and cause damage on the land we are looking at?

5. Has this land been cultivated before? If it has, how long ago was it under crops? Why did the farmer, who was here then, stop cultivating it?

6. From which directions does the wind blow at different times of the year? Is the sea near, and will one of the winds bring salt spray to the land? Are there any trees to protect the garden on the side from which the wind mostly blows? Will the trees keep too much sunshine from the crops?

7. What is growing on the land now? If it is trees, are



Picture 1. Good land well farmed

they old forest trees or young trees? Is it bush land, good grassland or poor grassland?

8. Is there a spring, lake or river near-by? Can water from there overflow and damage the land? If necessary can we easily bring water for irrigation? Can drainage water get away easily to river or lake?

9. What is the amount of the rainfall? Is there some rain all the year round, or does it rain only in some months of the year? When it rains where does the water go? Does most of it sink into the ground or run off it? Where does the drainage water go? Where is the water table in different parts of the land before and after rain? Is there an underground flow of water coming from another piece of land?

10. How deep is the top-soil? How deep is the sub-soil? What is the sub-soil like? Is the soil stony?

11. Are there wild animals like pigs and rabbits, that might damage the land? Are there many birds that could damage young seedlings, eat the fruit, etc.?

12. What signs, if any, are there of bad drainage or of erosion?

The answers to these questions will help us to foresee what difficulties we shall meet if we decide to farm this piece of land. Can we by good farming, wise planning and hard work overcome the difficulties, conserve the soil and get good harvests?

THINGS TO DO

1. If you are really looking for a piece of land to farm, make use of the questions given in this chapter to help you to choose.

2. If you are not looking for a new piece of land, take part of the land you are now farming and apply to it the questions given in this chapter. Write down both the good things and the bad things which your answers bring out. What should you do to conserve the good things and fight the bad ones?

3. Take some soil from different parts of the land and test it to find out how much humus there is in it. To make this test put some of the soil in a tin lid, and heat it over a flame. As the humus burns, you will see little sparks of fire. If you see only a few sparks, you will know that there is not much humus in the soil.

QUESTIONS

1. Why should you think about the slope of the land when you are choosing a place to make a garden?

2. How may a crop be damaged on land near the sea?

3. Why would you wish to know if there is a spring, river or lake near the land you are thinking of farming?

4. What use would you make of a lake near your farm, (*a*) if it is higher than the farm, or (*b*) if it is lower than the farm?

5. Why is it important to know if the land has been cultivated before? Why do you want to know when cultivation stopped?

6. What kind of soil is best for digging trenches in?

7. What animals damage crops in your district? What can you do to stop them?

8. How will the position of the water table in the soil help to decide about drainage and irrigation?

CHAPTER 2

WISE PLANNING: (1) STRIP CROPPING

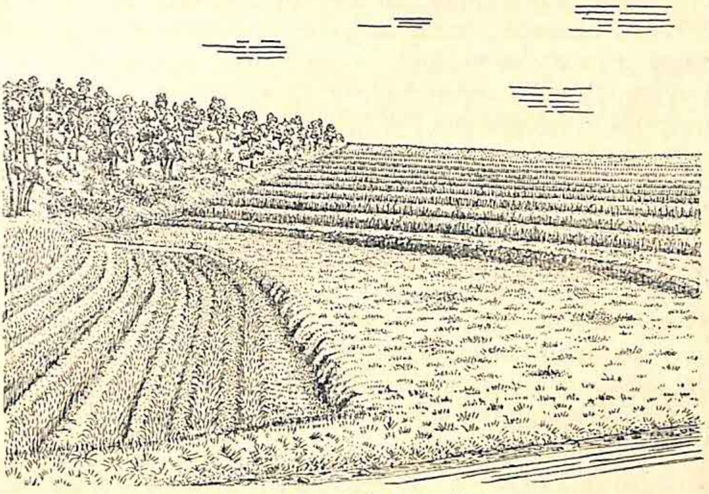
WHEN we have chosen the best piece of land we can find, we must, in order to conserve the soil, plan wisely how we are going to lay it out. There are three good plans, and which one we use depends on the slope of the land and the kind of soil. All three plans have one thing in common, however: the digging, planting and harvesting are always done across the slope and never up and down it. Banks, furrows, ditches, and rows of plants all cross the slope on or parallel to marked grade or contour lines.

If the slope of the land is gentle, the crops are planted in strips or belts across the slope. If the slope is steeper, the strips or belts are separated from each other by banks and ditches. If the slope is very steep, the hillside is made into terraces separated from each other by walls and ditches. These three ways of using the land are known as (1) strip cropping, (2) contouring or grading, and (3) terracing.

STRIP CROPPING

The word "strip", used in this sense, means the piece of land lying between two contour or grade lines, which have been marked across a slope. The crops are planted parallel to these lines.

As far as erosion is concerned, crops may be divided into two kinds—those which help to prevent erosion and



Picture 2. Strip cropping

to conserve the soil, and those which encourage erosion and damage to the soil. The first kind are *close-growing crops*. Some of these are upright plants like wheat, barley, rice. Others spread over the ground, covering and protecting the soil. Among the crops which do this are sweet potatoes, clover, calapagonium, peanuts, cowpeas (when grown as green manure), and so on. Both these kinds of close-growing crops protect the soil from sun, wind, rain, and run-off water.

The crops which encourage erosion are *open crops*. They are not planted close together; there is space between the rows of plants and between the plants in each row. These spaces are weeded and kept clean, so that such crops are sometimes called clean-tilled crops. Yams, tomatoes, taro, cotton, tea, pineapples, etc. are open- or clean-tilled crops. Rain splash and run-off water may damage the soil between plants of this kind, and sheet and rill erosion often begin in this way. In the tropics it is often best not to weed between open crops, for the weeds may do less damage to the crops and the land than will be done by leaving the soil bare and loose. The shallow roots of the weeds help to hold the soil in the heavy rain-storms.

In strip cropping, open- and close-growing crops are planted on alternate[1] strips. The run-off from between the plants of the open crop flows down to the strip below, where a close-growing crop is planted. Here the water is held by the plants, so that it flows slowly and sinks into the soil. The run-off from one strip is held on the next strip below it. For greater safety the open crops can be planted on narrow strips and the close-growing crops on wider strips.

When the land is fairly steep, the strips are narrow. Very narrow strips, or parts of strips, should not be tilled. They should be kept covered with grass or cover crops. These can be cut down before they flower, so that the seeds do not spread into other strips and cause more weeds. Steep strips should always be kept covered, for run-off water quickly makes gullies on bare land. The gullies damage the strips farther down the slope.

If there is much run-off from any strip, it is useful to plant a strip, from 3 feet to 9 feet wide, with grass or cover crops, so as to prevent damage to the land below it. Strip cropping in this way helps the farmer to fight against sheet, rill, and gully erosion, and thus to conserve his soil.

THINGS TO DO

1. Find any places in the district where farmers are strip cropping. What open crops and what close-growing crops are they growing?
2. Find out in what parts of your district strip cropping

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[1] Alternate: every second one.

would be useful. To do this you must see how steeply the land slopes.

3. Make a list of the crops you plant at your school or in the village gardens. Divide the list into open crops and the two kinds of close-growing crops.

QUESTIONS

1. What are close-growing crops? Name five of them.
2. What are open crops? Name five of them.
3. Why is it sometimes useful to plant the open crops on narrow strips and the close-growing crops on wide strips?
4. What would you do if one part of a slope is much steeper than the rest of it?
5. How does planting open- and close-growing crops on alternate strips help to conserve the soil?
6. Why are open crops sometimes called clean-tilled crops?
7. Why is a crop sometimes not weeded in the tropics?

CHAPTER 3

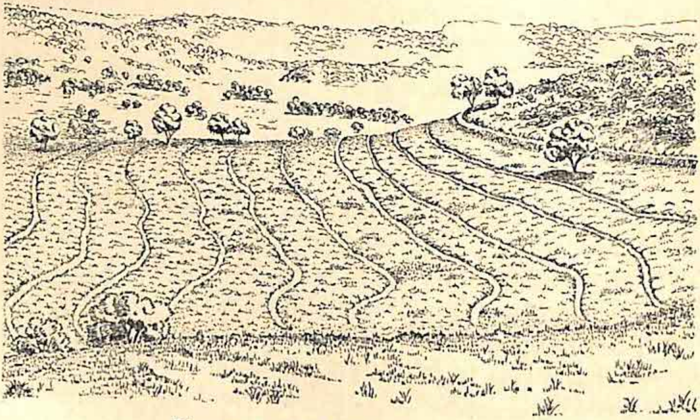
WISE PLANNING: (2) CONTOUR OR GRADE BANKS AND DITCHES

WHEN the land has been contoured or graded, it is often necessary to dig drainage ditches between the strips. If the soil is porous, the slope gentle, and the rainfall not too heavy, the land is contoured and ditches are dug along the contour lines. This means that the ditches are level, and drainage water collects in them. The water does not flow away, but sinks slowly into the soil in the ditches. Thus the water remains in the soil for the crops, and none of it is wasted. To hold the water in this way helps to conserve the soil and to improve the crops.

On steeper slopes, where the rainfall is heavier, or where the soil is less porous, grade lines with a gentle slope are marked out on the land. (See Appendices 1 and 2 of this Book.) The ditches are dug along the grade lines. Because the ditches slope gently, the drainage water flows away slowly, and much of it sinks into the soil. To make it flow more slowly still, small dams of soil can be made across the ditches every few yards.

The soil dug out when making ditches on contour or grade lines is put on the side nearer the top of the slope and between 6 and 12 inches from the edge of the ditch. This makes a bank on which grass or a close cover should be planted as soon as possible, to prevent the soil being washed back into the ditch. The posts which mark the contour or grade lines (see Appendix 3 Section III) stand up in these banks, which help to absorb the run-off water from the strips.

Each time a crop is harvested, the rubbish and green manure are dug into the soil at the lower edge of each strip



Picture 3. Graded land with ditches

near the bank. So this edge of the strip becomes higher, and, as time goes on, the strip becomes level; then it may begin to slope towards the open side of the ditch at the edge of the strip next above it. This levelling of the strips helps to keep the water on them, and to stop run-off or drainage from strip to strip. Because the strips become level, they are often called *tablelands*.

THINGS TO DO

Walk round your district and look out for land which, if it were yours, you would farm on the strip cropping plan. Try also to find land which you think requires contour or grade banks and ditches.

QUESTIONS

1. Under what conditions would you make your ditches on the contours?
2. Under what conditions would you make the ditches on grade lines?
3. How would you set about making the strips level? What name is given to the level strips?

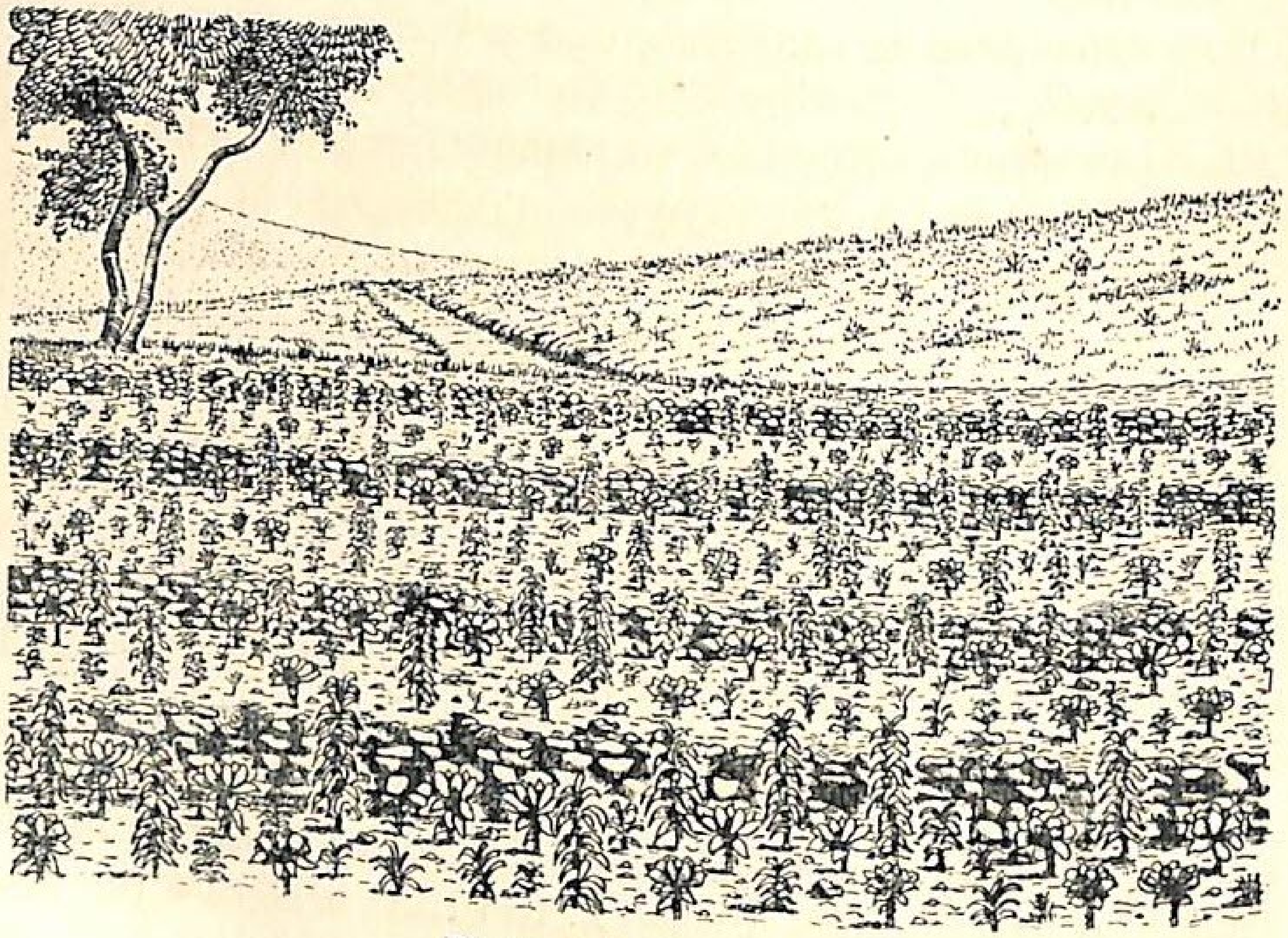
CHAPTER 4

WISE PLANNING: (3) TERRACING

STRIP cropping and tableland farming help to prevent erosion and to conserve the soil on gentle slopes, but another method is needed on steep slopes. Rain and run-off water can wash a whole crop off a steep slope, and men have had to learn how to keep both the crops and the soil in place. They found that they could do so by making walls across the slopes and levelling the soil between the walls. Pieces of farming land prepared in this way are called terraces.

Terraces, then, are level, often narrow, strips of land across a steep slope, and they are separated from each other by stone walls. They are generally found in hilly country where there are many people, who have at some time worked together to collect the stones and build the walls.

There are many terraced gardens and plantations on hilly slopes in India, Burma, Ceylon, China and Japan. The people harvest many tons of rice, tea and other crops from this land, which without the terraces could not be cultivated at all. The largest terraced slopes in the world are in the Philippine Islands, and there are terraced gardens in Peru and Mexico in America. In Southern Europe the



Picture 4. Terraces

grape vine grows on terraces on mountain sides in Spain, France, Italy, and Cyprus.

When making the terraces, the walls are built two feet high if the soil is heavy, and three to four feet high if the soil is light and porous. The soil between each pair of walls is then made level from the top of the wall on the lower side of the slope to the bottom of the wall on the upper side. The ditches to drain the terraces are made at the bottom of the walls.

"Broken" terraces are small level places made on a hillside and held in position by short walls. The remainder of the hillside is not cultivated, but is planted with grass, bushes or a cover crop. On each of the "broken" terraces a tree or a group of trees may be planted. Rubber trees and groups of bananas are often grown in this way.

Gardens made according to any of the plans given in these three chapters are easy to work. Ditches and banks can be made with hoes, and the tablelands and terraces can be levelled with spades and hoes. If the garden belongs to a school, the pupils can easily find the part of the garden where they should be working, and all the work can be done by them. A history of each strip, tableland or terrace can be written down in a book kept for the purpose. The history should give the kind of soil; the crops planted, together with the dates of planting; the weather; the difficulties experienced at different times of the year; and information about the harvests.

THINGS TO DO

1. Look for pictures of terraced land. In which countries were the pictures taken? What crops are grown on the terraces?

2. Prepare the page of a book to show how you would keep a history of a terrace or strip. You will find that the best way is to divide the page into columns.[1]

QUESTIONS

1. Name three countries where there are many terraced gardens.
2. On what kind of land are terraces needed? What tools and materials are required for the work?
3. How are terraces drained?
4. What are "broken" terraces? What crops are usually grown on them?

CHAPTER 5

PREPARING THE LAND

MUCH soil is lost by unwise clearing of the land, because, when man uncovers the soil, he opens the door to the thieves, wind and water. We must clear the land wisely if we wish to conserve the soil.

1. *Trees*

Trees are precious and beautiful things. Men and animals enjoy their shade, the soil needs their protection, and they help to bring rain to the land. On the other hand, man must plant crops for food and grass for his animals, so trees must be cut down. But before a farmer cuts down any tree, he should ask himself, "Is it necessary to take away *this* tree?" If it is not really necessary, then he should allow the tree to remain. Too many trees in many parts

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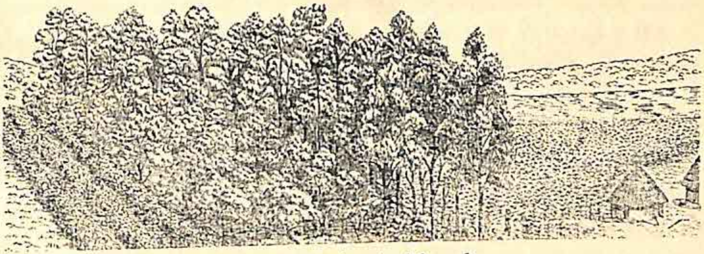
[1] Column: a division of a page made by drawing lines from top to bottom of the page.



Picture 5. A wind-break

of the world have been cut down, and doing so has brought trouble and loss to many farmers.

It is always good to leave trees as a wind-break. Let the trees stand on the side of the garden from which the wind usually blows. A wind-break must have several lines of trees in it; two or three lines are not enough. Some of the trees in the wind-break should be tall, and some short. If all are tall, the wind will blow between their trunks on to the garden. Trees protect the plants and soil for a distance of twenty times their height; a tree ten feet tall will give protection for 200 feet on the side away from the wind.

If there are no trees that can be left as a wind-break, young ones should be planted. Do not choose shallow-rooted trees, as they may be blown over in a strong wind and damage the crops. Plant different kinds of trees in a wind-break: some that grow quickly and some that grow slowly; some that grow tall, others that remain short; some that grow bushy near the ground and some that have their branches and leaves high above the ground. When planting the trees, put them close together, for some may die. Later, if there are too many trees, some of them can be cut out. A wind-break made in this way both improves the land and protects the crops.

2. *Keep the soil covered*

After cutting down the trees that must be taken away, begin work at the highest part of the land. Clear across the slope, not down it. Mark off the highest grade or contour line as soon as you can. Along this line put the stones and logs from the cleared land, and dig the first drain across the slope below this line. Leave the small bushes, branches, and leaves to cover the soil until you have marked the second grade or contour line, and dug the second drain below it. Then clear the top strip or terrace, dig it, and plant the first crop. If this or any other strip is a large one, do not wait until you have cleared it all before you begin planting, but dig and plant as you clear across the slope. The thing to remember is to get the land covered again as soon as you can; do not let it stay bare any longer than is necessary.

Work down the hillside in this way, marking each line, making the drain and the bank, digging leaves and green, soft stems into the soil, putting the hard stems at the side of the garden, and planting as quickly as possible. Places which are too steep for you to cultivate should be left under bush, grass, or a cover crop.

THINGS TO DO

1. Look at any wind-breaks you can find in the district. Are they natural wind-breaks, or have they been planted? What kind of trees are in them?

2. From which direction does the wind most often blow? Draw on a piece of paper the points of the compass, and then draw an arrow in red to show this direction. Write on the arrow the names of the months when this wind blows.

3. When you next clear new land to make a garden, follow the order of work set out in this chapter.

QUESTIONS

1. If a field is 600 feet wide, what height should the tallest trees of the wind-break be?
2. Why should the trees of a wind-break be of different heights?
3. Why would you begin to clear and plant from the higher part of the slope?
4. Why would you make the ditch before you finish clearing and planting?
5. Why should the soil be covered again as soon as possible?

CHAPTER 6

TILLING AND MANURING THE LAND

THE farmer who chooses his land wisely and prepares it carefully has made a good start. To conserve the soil and, if possible, to improve it, he must also till it wisely. The crumb structure of the soil in many parts of the world has been destroyed by tilling it too deeply and too often.

Many Agricultural Officers now say that in the tropics it is best to dig only the top four inches of the soil, and this helps to prevent erosion. They also say that digging the land with hoes does not damage it so much as ploughing it. It is true that, with only simple tools, the Chinese have fed millions of people for many centuries, and have at the same time kept their land fertile.

In this century there are millions of people who have no land of their own, and in many countries those who work on the land have become fewer. In these countries farms have become bigger, and the farmers use machines. But, even if ploughs are used, they can be set so that they do not dig too deeply. Tilling the soil is good, because it lets air and water into the soil, but even a good thing can be done too often. As has been said again and again in these books, the farmer in the tropics should try to keep the soil covered as much of the year as possible. For example, a green manure crop planted between the rows of the food crop, and dug in with the rubbish of the food crop, will both conserve and improve the soil.

One of the best ways of taking care of the soil is to see that it has plenty of humus in it. Humus protects the soil and helps to make it fertile. (See Book 4, *Better Ways of Farming*, Chapter 15.) Green manures, animal manure, crop rotation all help to protect and improve the soil.

THINGS TO DO

Read the following again:
Digging—Book 4, Chapters 11 and 12.
Humus—Book 4, Chapter 15.
Green manures—Book 5, Chapters 2 and 3.
Crop rotation—Book 5, Chapter 4.
Animal manures—Book 6, Chapters 10 to 16.

QUESTIONS

1. How may too much digging damage the structure of the soil?
2. What could you do to improve the soil on your own land?

CHAPTER 7

MAN'S GREATEST WORK

Two men, who know much about the land, have written that the greatest thing men can do is to try to get control of the soil. In this series of books, we have read how we may do this—how we may try to protect, conserve, and improve the soil; how we may care for the land on which we depend so much for health and wealth, and on which, through work, we may grow strong in body and character. But we shall not win these prizes if we do only some of the things these books tell us, or do them only sometimes. Unless we do them all the time we shall be like people who lock their doors against thieves, but sometimes leave their windows open. We must follow the good ways all the time.

The farmer, who takes care of his land, will find that it takes care of him by giving him bigger and better harvests as the years go by. By studying the soil, its structure and its needs, by working with Nature and not against her, and by helping others to do the same, he will conserve both soil and water, improve the land, increase his harvests and help to give the nations of the world more of the food they need. He will hand on a richer soil to those who come after him, and through this they will be a healthier, happier and better people.

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HOW TO CONTOUR OR GRADE THE LAND

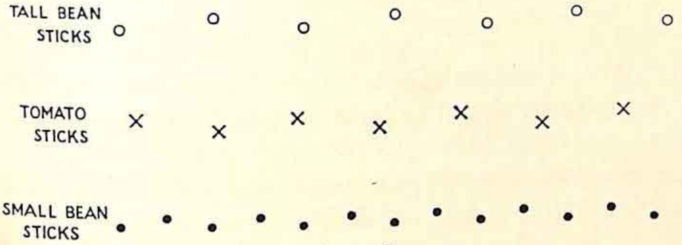
APPENDIX 1

CONTOURS AND CONTOUR LINES

We often see contour lines on maps. Each line joins points which are the same height above sea-level. Every day we see around us other lines, which are like contour lines. For example, if you are reading this in a classroom, you can look up and see one where the walls meet the ceiling. Every point on this line is the same height from the floor.

There may be other things in the classroom that are the same height from the floor, but which are not joined by lines. The tops of desks or tables, of seats or boxes, the edges of pictures or blackboards, may be the same height above the floor. If you put a string across the tops of all the desks of the same height, you will have joined them by a contour line. If the desks are all arranged in a straight line, the contour line will be straight also. If the desks of the same height are scattered about the room, the contour line will not be straight. It will bend according to the position of the desks.

In the garden you may also find things of the same height. Let us imagine that there we have small bean plants, tomatoes, and tall bean plants growing. The small beans have sticks two feet high to support them, the tomatoes have sticks four feet high, and the tall beans have sticks six feet high. If the sticks in each row have all been put the same distance into the ground, they will all be the same height, and a string put across their tops will be like a contour line. This plan shows the position of the sticks:

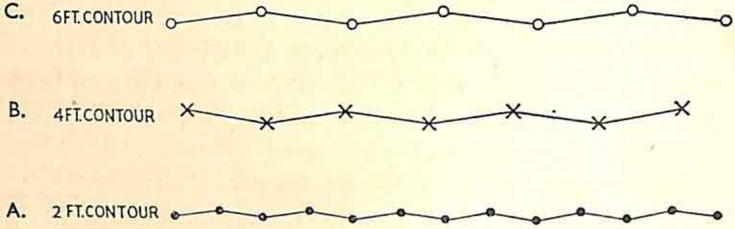


Picture 6

(A plan shows what we see when we look down on anything from above. If it is a plan of a house or of a room or of a piece of land, it shows the position of the different rooms in the house, or of the furniture in the room, or of the things on the land. It is not like a picture, which shows the height of the things in the picture, their shape as we look straight at them, and perhaps their colour.)

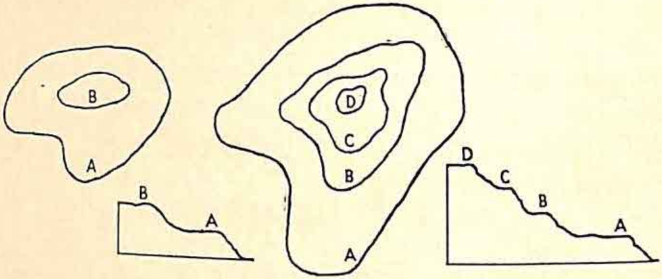
In the next plan we show all the sticks of the same height joined with a line. Line A joins the tops of the two-foot sticks; line B the four-foot ones, and line C the six-foot ones. The three lines are like the contour lines on a map. They are not real lines in the garden, but in the plan they show the points which are the same height above the ground.

A map shows us the country as we would see it if we were flying over it in an aeroplane. From the aeroplane we can



Picture 7

probably see where the hills and valleys are, but we cannot judge their height. In the same way we cannot tell the height of places on a map, unless contour lines are added to show this. The contour map of a piece of country may be like this:

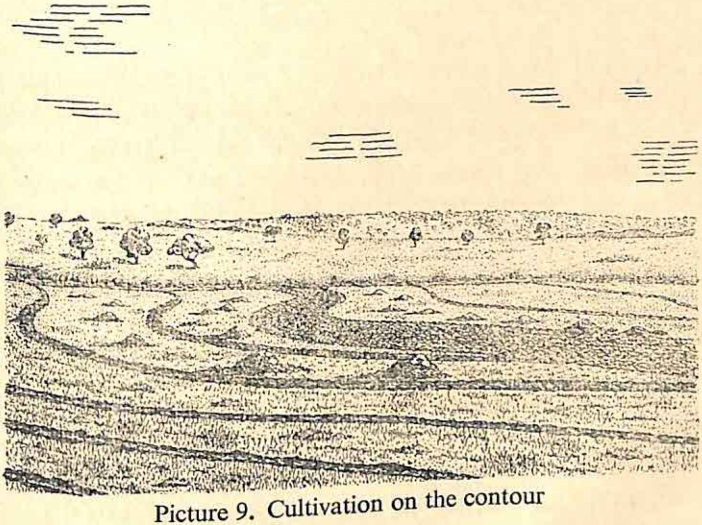


Picture 8

This shows two hills, one of which is higher than the other. Contour line A joins places that are 100 feet above sea-level. Contour line B joins places that are 200 feet above sea-level; line C those that are 300 feet; and line D those that are 400 feet. The lines show that the small hill is 200 feet high and the bigger hill 400 feet high. These contour lines are not marked on the ground, but they are drawn on the map after careful measurements have been made on the ground.

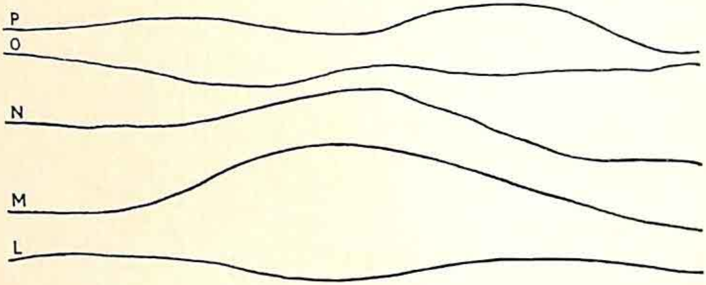
Contour lines can be marked on the ground, if they are needed, and this is what we do when we contour a garden. We find and mark places which are the same height above sea-level. We then join these places with a line, which may be a string, a bank or a ditch. All the places on this line are at the same level, and a ditch dug here will not allow water in it to flow away. The water can only sink into the soil, for the ditch runs across the slope without going either higher or lower at any point.

The contour lines in a garden are measured so that there is, as on maps, a certain agreed height between them. There may, for example, be a rise of three feet between the contour lines in a certain garden, so that any point on the upper line is exactly three feet higher than any point on the next lower line. But the width of the strip



Picture 9. Cultivation on the contour

of land between the two lines will be more than three feet and will be different at different places. This is a plan showing five contour lines across a slope, each line being three feet higher than the one below it.



Picture 10

THINGS TO DO

1. Find six desks of the same height in the classroom, and join them with a long string. Draw a plan showing the desks and put in the "contour line" joining them.

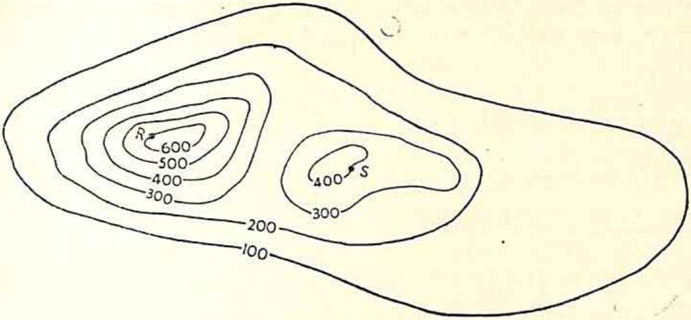
2. Find five plants of the same height in the garden. Draw a plan and mark their places in it. Join them with a "contour line".

3. Draw a plan of your classroom, verandah or school hall.

QUESTIONS

1. What is a contour line?
2. What is the difference between a plan and a picture?
3. In Picture 10 how many feet is line P above line L?

4. Look at this map, and write a few sentences describing the country. How many feet is S below R?



Picture 11

5. Will a ditch made on a contour go up, down, or across the slope?

6. If water collects in a ditch dug on a contour, where will it go? Explain your answer.

APPENDIX 2

GRADIENTS[1] AND GRADE LINES

We have often read in these books about making banks or ditches along grade lines. These grade lines are made so that the water in the ditches flows slowly and gently away, and does not carry with it the soil from the garden, or rub away the sides and bottoms of the ditches.

The word "grade" comes to us from the Latin word "gradus", a step. To grade things means to arrange them in order of height, weight, age, or some other measurement. A grade line is one which slopes equally all along its length. The amount it rises or falls in a measured length is called the gradient.

Mark a point A at a corner of a table. Measure 1 foot along the edge of the table, marking the point B. Hold a ruler upright at B, and then hold a straight piece of wood with one end on the table at A, and the other end one inch above the table at B. The piece of wood slopes up gently from A to B; it rises 1 inch in 1 foot, that is 1 inch in 12 inches.

From B measure another foot along the edge of the table, and mark the point C. Get someone to hold a straight piece of wood from 1 inch above the table at B to 2 inches (on a second ruler) above the table at C. The second piece of wood rises 1 inch between B and C, which are 12 inches apart. The gradient is therefore the same as that of the first piece of wood. If we take any two points

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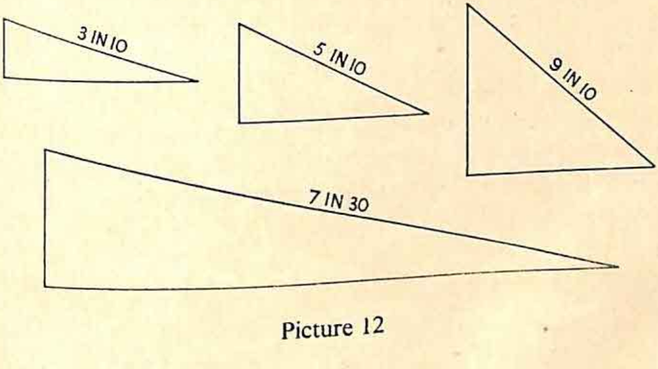
[1] Gradient: a slope.

1 foot apart between A and C, we shall find that there is a difference in height of 1 inch between the two points directly above them on the sloping pieces of wood. So the gradient is the same all the way from A to C.

Repeat the work of the last two paragraphs, this time sloping one straight piece of wood from A to the 2-inch mark on the ruler at B and the other piece from the same mark on the ruler at B to the 4-inch mark on the ruler at C. In this case, where two points between A and C are 12 inches part, there is a difference in height of 2 inches between the two points directly above them on the sloping pieces of wood. There is a rise of 2 inches in every 12 inches, that is a gradient of 2 in 12.

We must be careful, in writing a gradient in this way, that we use the same unit of measurement for both the height and the distance. A gradient of 1 in 50 means a rise of 1 inch in 50 inches or of 1 foot in 50 feet.

Here are drawings of some gradients; the unit of measurement is $\frac{1}{10}$ inch:



Picture 12

A useful gradient for ditches is 1 in 90. With this gradient the water in a ditch flows slowly and does not rub away the soil. 1 in 90 is the same as 4 in 360. 360 inches =30 feet=10 yards. So a gradient of 1 in 90 is the same as a rise of 4 inches in every 10 yards. In Appendix 3, Section III we shall read how to make grade lines with a gradient of 1 in 90.

THINGS TO DO

Make some drawings of gradients. Draw a horizontal line 4 inches long, and at one end draw another line 1 inch long at right angles to it. Complete the triangle. The sloping line you have just drawn rises 1 inch in 4 inches, and shows a gradient of 1 in 4. Make other drawings to show gradients of 2 in 3, 1 in 5, and 3 in 7.

QUESTIONS

1. In some countries eggs are graded before they are sold. What does this kind of grading mean?
2. In some schools the classes are called "grades". What do you think is the measure for grading pupils in a school?
3. At the side of railway lines one often sees small pieces of wood on short posts with, for example, "1 in 157", "3 in 294", or "7 in 100" painted on them. What is the meaning of these?
4. What is a useful gradient for drainage ditches when you want to be sure that the water will not take away the soil from the bottom and sides of the ditch? What is this gradient when written in inches and feet and in inches and yards?

APPENDIX 3

CONTOURING AND GRADING

SECTION I. THE TOOLS

FOR contouring or grading a garden we need a T-frame and a bamboo pole.

1. *The T-frame*

We shall require these things:

(*a*) A piece of light, strong wood 6 feet long, 3 inches wide, and about ¾ inch thick.

(*b*) Another piece of wood 18 inches long and the same width and thickness as the first piece.

(*c*) Two pieces of glass tubing, about ⅛ inch in diameter[1] and 6 inches long.

(*d*) Two pieces of rubber each about 1 inch by 1½ inches (part of the inner tube of a car will do).

(*e*) About 18 inches of rubber tubing that will fit tightly on to the ends of the glass tubes.

(*f*) 8 strong drawing pins.

(*g*) 4 screws or nails about 1½ inches long.

(*h*) 2 very small corks to fit the glass tubes.

To make the T-frame:

A. The person who will use the T-frame marks his eye level on a wall. Measure the height of this mark from the

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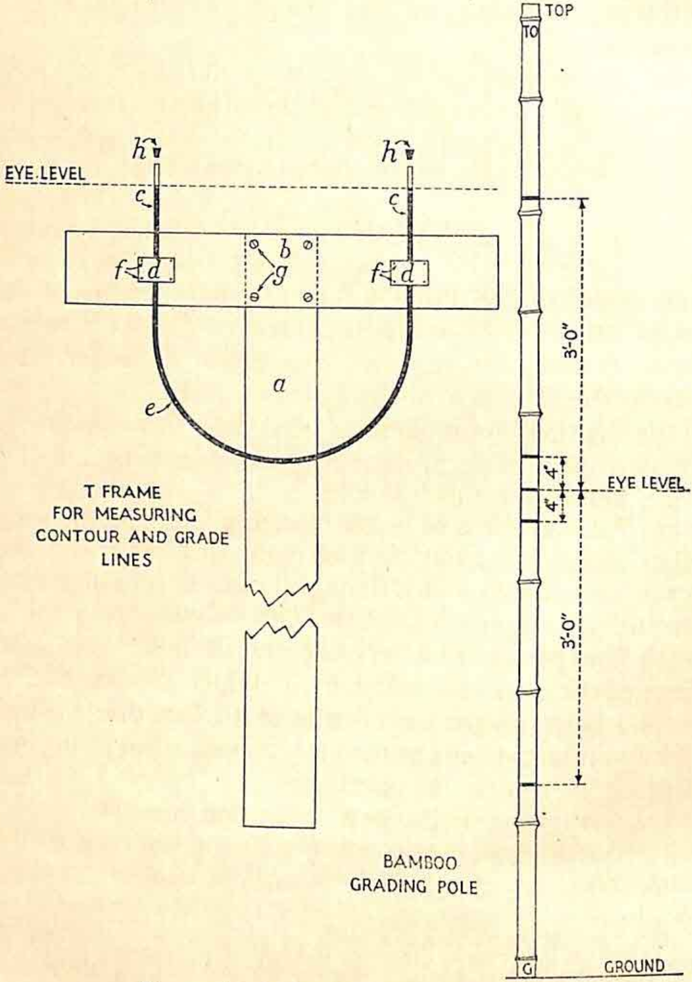
[1] Diameter: measurement from side to side of a circle through the centre.



Picture 13. T-frame and bamboo pole

floor, and subtract 2 inches. Cut the piece of wood (*a*) to this length, making sure that the ends are at right angles to the length.

B. Cut the ends of the piece of wood (*b*) straight and nail it at right angles across one end of piece (*a*) to make the letter T. Be careful to get the angle correct and to get the long piece of wood exactly in the middle of the small piece.

C. Along each arm of the T measure 3 inches from the point where the two pieces of wood meet. Measure 1 inch up the arm, and with 4 drawing pins (*f*) fix one of the pieces of rubber (*d*) so that it holds firmly in place one of the glass tubes. In the same way fasten the other glass tube to the other arm of the T.

D. Join the lower ends of the glass tubes with the rubber tube.

To fill the glass tubes with ink:

(*a*) Take an 8-ounce bottle with a lip to make pouring easier. Pour in ink until it is about an inch deep. Fill the bottle with water, put in a cork, and shake the bottle. See that the ink is a good blue-black colour.,

(*b*) The person who will use the T-frame, and who from now on will be called the "sighter", holds the T-frame upright and at right angles to his face, while someone else pours the ink and water mixture slowly into one of the glass tubes. He continues pouring until the ink rises in both tubes to the level of the sighter's eyes.

(*c*) Put the small corks firmly into the top ends of the glass tubes. The corks should always be kept in the tubes except when the sighter is actually using the frame. They keep the ink from evaporating or from being spilt when the frame is being carried about the garden. They must, of course, be taken out before the sighter uses the frame to take a sight.

2. *The bamboo pole*

The things needed are:

(*a*) A strong, yellow bamboo about 10 feet long and 2 inches in diameter.

(*b*) Red and blue marking pencils or paint.

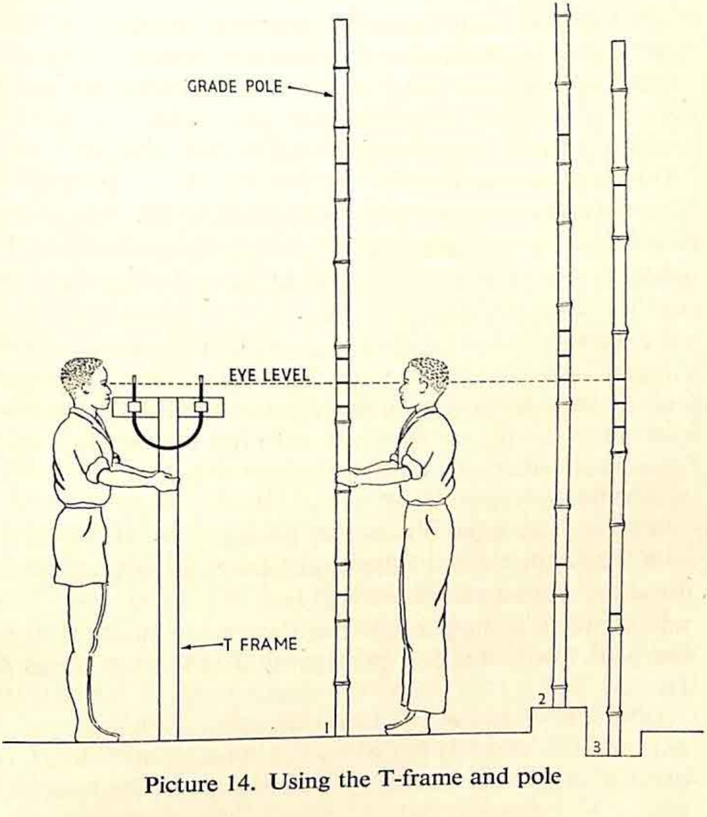
To measure and mark the bamboo pole:

(*a*) Cut the two ends of the bamboo straight on the outside of a node. With pencil or paint write a large "G" on the end that will always stand on the ground. Write "TOP" at the other end.

(*b*) Stand the T-frame and the bamboo on level ground or a level floor, so that the sighter can look along the ink levels in the glass tubes to the bamboo. Take the corks out of the glass tubes, and make sure that the top of the ink column in both tubes is at the sighter's eye level. Make a mark on the bamboo with the blue pencil at the same level as that of the ink in the tubes. At this mark draw a blue circle round the bamboo, making it clear enough to be seen at a distance of 10 yards. Write "EYE LEVEL" beside the circle.

(*c*) Lay the bamboo on the ground. Mark a point 4 inches on either side of the blue circle, and at these points draw red circles round the bamboo. Using the red circles we can mark out a grade line with a rise or fall of 4 inches every 10 yards, that is a gradient of 1 in 90 (see Appendix 2).

(*d*) Now measure 3 feet on either side of the blue circle, and make two more red circles at these points. With the help of these two circles we can mark out contour lines with a 3-foot rise or fall.



Picture 14. Using the T-frame and pole

SECTION II. PRACTISING WITH THE TOOLS

Before trying to mark out contour or grade lines in the garden, it is better to practise in a room or on a level piece of ground. Let us suppose that we want to teach the pupils of a school to use the T-frame and the bamboo pole.

(*a*) The sighter holds the T-frame perfectly upright, at right angles to his face, and with the corks out. He first makes sure that the ink levels are in line with his eyes.

(*b*) Another pupil holds the bamboo pole upright with its lower end on the ground a few yards away. As the ends of both the frame and the pole are at the same level, the sighter should see the ink levels pointing to the blue, eye-level circle on the pole.

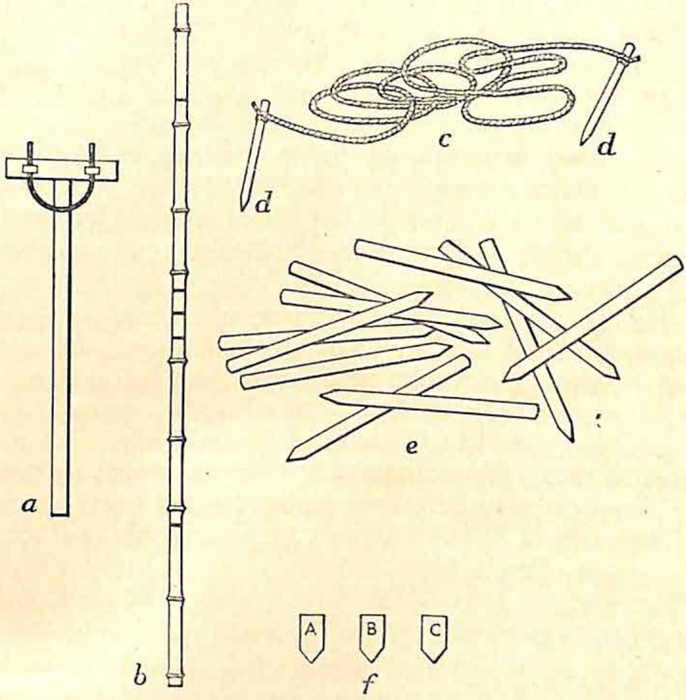
(*c*) Repeat this in different parts of the room with the T-frame and pole always on the same level to show the pupils that, when frame and pole are standing on the same level, the ink levels always point to the blue circle.

(*d*) Now stand the pole on something, such as a box, to raise it above the floor level. The ink levels now point to a place below the blue circle on the pole. If the box is 4 inches high, the ink levels will point to the red circle 4 inches *below* the blue circle.

(*e*) If the T-frame is now put on a box and the pole on the floor, the "reading" will be *above* the blue circle. If the box is 4 inches high, the reading will be on the red circle 4 inches above the blue one.

(*f*) In the same way, when the pole stands at a level 3 feet *above* the T-frame, the reading is on the red circle 3 feet *below* the blue circle. When the pole stands 3 feet *below* the T-frame, the reading is on the red circle 3 feet *above* the blue circle.

(*g*) When the pupils understand the above, they are ready to begin measuring contour or grade lines in the garden.



Picture 15. Things required for setting out contour or grade lines

SECTION III. SETTING OUT CONTOUR OR GRADE LINES

1. *The things required*

(*a*) The T-frame.

(*b*) The bamboo grading pole.

(*c*) 10 yards of rope.

(*d*) Two strong, pointed, hard sticks, about 18 inches long, to which we tie the rope (*c*).

(*e*) Many strong posts, each 3 feet long, of hard wood and pointed at one end.

(*f*) A number of small, flat pieces of wood, pointed at one end, each with a number 1, 2, 3, etc., or a letter A, B, C, etc., painted on it.

Before the work can begin the land must be cleared enough for the workers to be able to walk about and do the sighting. We must also have made up our minds whether we are to mark a contour line or a grade line. If a grade line is wanted, we must know in which direction the ditches should slope to carry away the water, and what the gradient is to be. If the gradient is not to be 4 inches in 10 yards (1 in 90), we must prepare a pole to give the grading required.

2. *The team*

The work should be done by a team of six:

(*a*) The sighter, who carries the T-frame and does the sighting.

(*b*) The grader, who carries the grade pole and moves it about as the sighter orders until it is in the right place.

(*c*) Measurers 1 and 2, who each carry one of the sticks to which the 10-foot rope is tied, and who do the measuring.

(*d*) Post-carriers 1 and 2, who carry the 3-foot posts and stick them in the ground.

3. *Marking a grade line*

When marking a grade line, it is best to begin at the side of the garden where the ditch will be lowest, and to measure the line so that it rises 4 inches every 10 yards. If the ditch is begun at this end, any water that collects in it before the work is finished will flow away from the garden and not over it.

(*a*) The sighter stands at the lowest point of the top grade line with the T-frame beside him on the same level, and pointing across the slope. Measurer 1 puts his stick in the ground by the T-frame.

(*b*) The grader holds the bamboo pole upright about 10 yards from the sighter, measurer 2 helping to get the distance with the aid of the rope. The sighter tells the grader to move the pole this way and that until the ink levels are in line with the red circle which is 4 inches below the blue circle. Measurer 2 moves about with the grader to make sure that the pole is always 10 yards from the T-frame.

(*c*) When the pole is in the right place, measurer 2 puts his stick in the ground beside it.

(*d*) The grader takes the pole about 10 yards farther on, and the sighter stands the T-frame where the pole was. Measurer 1 takes up his stick and moves on to help the grader to place his pole 10 yards from the T-frame. The post-carriers put a post in the ground where the T-frame first stood.

(*e*) When the next sight has been taken, the grader and the sighter move as before. Measurer 2 takes up his stick and moves on to help the grader. The post-carriers put in the second post. The work goes on in this way until the grade line is completed.

4. *Marking a contour line*

(*a*) The team works in the same way as it does when a grade line is being marked out, except that the sighter gets the blue circle on the pole in line with the ink levels of the T-frame.

(*b*) When the top contour line has been marked out, the place for the second line to begin is found by standing the T-frame at the end of the first line, pointing it downhill, and moving the pole until the top red circle on the pole is in line with the ink levels. If the distance between the blue circle and the top red circle on the pole is 3 feet, the height between the contour lines will also be 3 feet.

5. *Notes*

(*a*) It is useful to paint the tops of the posts of contour or grade lines 1, 3, 5, etc. red and those of lines 2, 4, 6, etc. white.

(*b*) When digging the ditch or making the bank, string tied between the posts helps the diggers to keep to the line.

(*c*) Chapter 3 of the first part of this book tells how to make the ditches and banks.

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